

**SUBCHAPTER 4. REMEDIAL INVESTIGATIONS****7:26E-4.1 Remedial investigation requirements**

(a) A remedial investigation is necessary at each area of concern with contaminants which exceed the applicable unrestricted use soil remediation standards or the applicable groundwater or surface water remediation standard pursuant to N.J.A.C. 7:26E-1.13. The purposes of a remedial investigation are to:

1. Delineate the horizontal and vertical extent of contaminants in all media at the site pursuant to (b) below;

2. Determine the general surface and subsurface characteristics of the site, including, without limitation, the depth to ground water;

3. Identify the migration paths and actual or potential receptors of contaminants on or through air, soil, bedrock, sediment, ground water, surface water, and structures at a contaminated site;

4. Collect and evaluate all data necessary to evaluate remedial action alternatives. These data may be gathered through studies including, without limitation, treatability studies, bench scale studies and pilot scale studies (these studies may be conducted pursuant to EPA 540/2-89/058 "Guide for Conducting Treatability Studies Under CERCLA").

i. Any such data collection, shall be initiated as soon as the general extent of contamination is known, usually after the first delineation phase and, at a minimum, these studies shall be initiated by the end of the second delineation phase;

5. Collect and evaluate all data necessary to evaluate the actual and potential ecological impacts and to characterize all natural resource injuries, including the nature and extent of injury to soil, water, flora and fauna, caused by the contaminants of potential ecological concern at the site;

6. Collect all data necessary to develop permit limitations for any discharge to an environmental medium which may be required for any remedial action alternative under consideration;

7. Identify containment and/or stabilization activities to prevent contaminant exposure to onsite receptors and to prevent the offsite migration of contaminants while remedial alternatives are being evaluated.

(b) The delineation of the horizontal and vertical limits of contamination to the applicable unrestricted use remediation standard for all media shall be conducted as part of the remedial investigation. When the future use of an area under investigation is known to be restricted and the property owner has agreed to place a deed notice on the

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property appropriately restricting its use, the person responsible for conducting the remediation may delineate the horizontal and vertical limit of the soil contamination to the applicable restricted use standard or the applicable ground water impact soil cleanup criteria, whichever is lower. The person responsible for conducting the remediation at the site shall determine if soil contamination has migrated off the property, at any depth, above the applicable unrestricted use standard. Delineation samples shall be biased to identify any migration paths of the contaminant. Samples shall be biased based on professional judgment, area history, discolored soil, stressed vegetation, drainage patterns, field instrument measurements, odor and other field indicators. Delineation shall be accomplished by either:

1. Presentation of sample data that indicates contamination is below the applicable remediation standard. This may be accomplished after a remedial action has been implemented; or

2. By establishment of a contaminant gradient as follows:

- i. Contaminant levels decrease by:

- (1) Ten percent or more between the initial characterization sample and each of two sequential delineation samples; or

- (2) A factor of five or more between the initial characterization sample and a single delineation sample; and

- ii. Once a contaminant gradient has been established, the approximate limits of contamination may be reasonably estimated by extrapolation in order to complete the remedial investigation. However, when a contaminant gradient is used to estimate the limits of contamination, the extent of contamination above the applicable unrestricted use remediation standard shall be confirmed using laboratory analyses prior to the completion of a remedial action; and

3. If a vertical soil contaminant gradient has not been established to the water table:

- i. For contaminants having water solubility greater than 100 milligrams per liter at 20 degrees Celsius to 25 degrees Celsius, saturated zone soil shall be delineated for residual product pursuant to N.J.A.C. 7:26E-2.1(a)11, and for direct contact soil cleanup criteria; and

- ii. For other contaminants, delineate for direct contact soil cleanup criteria.

**7:26E-4.2 Remedial investigation workplan**

(a) If a remedial investigation workplan is required by the Department in an oversight document or by the ISRA or UST programs, the workplan shall include proposals to complete all applicable requirements pursuant to N.J.A.C. 7:26E-4.1 and 4.3 through 4.7. The remedial investigation workplan shall be presented in a format that corresponds to the outline of this section.

(b) The remedial investigation workplan shall include:

1. A detailed schedule for all remedial investigation activities, including timeliness and target dates for:

- i. The start and completion of all field activities;
- ii. Receipt of analytical results required in N.J.A.C. 7:26E-4.1 and 4.3 through 4.7; and
- iii. Submission of all reports to the Department;

2. A description of the role of principal personnel who will participate in the remedial investigation:

i. The information in (b)2i(1) and (2) below about project personnel, including the project manager and, if applicable, a facility contact, legal contact, and contractor and subcontractor contacts, shall be provided. In addition, the telephone number of the project manager shall be provided.

(1) Responsibilities; and

(2) Authority on the project.

ii. If the principal personnel designated on the project change, information for the new personnel shall be submitted to the Department within 30 calendar days of such change;

3. The following historical information, unless the remediation is directed at either a specific discharge event, rather than a particular area of concern at a site, or any underground tank or underground tank system:

i. Historical site plans, if available, after completion of a due diligence search, and facility as-built construction drawing detailing, at a minimum, all information pursuant to N.J.A.C. 7:26E-3.2(a) and, in addition, topography using two-foot contours, potential contaminant conduits including all subsurface utilities. Maps depicting the entire site shall be scaled at one inch to 200 feet or less and individual area of concern maps shall be scaled at one inch to 40 feet or less. If

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more than one map is submitted, maps shall be presented as overlays, keyed to a base map; and

ii. An interpretive aerial history pursuant to N.J.A.C. 7:26E-3.1(c)1vi including all photos. Matched pairs shall be provided, if available, to allow for stereo viewing. Photos shall include a north arrow, **bar scale**, date and source of photo, and site boundaries. Matte finish reproductions are preferred;

4. Descriptions of the following unless the remediation is directed at either a specific discharge event, rather than a particular area of concern at a site, or any underground tank or underground tank system. If applicable, the Department Geographic Information System shall be used as a source of information for (b)4i through vi below:

i. The physical conditions of the site and surroundings, including a general description of soils, geology, hydrogeology, and topography;

ii. The usage, distance to, flow direction, and names of surface water bodies within one-half mile of the site boundary, with emphasis upon water bodies topographically or hydraulically downgradient of the site that may receive site discharges or runoff;

iii. A copy of the United States Geologic Survey (USGS) 7.5 minute topographic quadrangle that includes the site and an area of at least a one mile radius around the site shall be required. This map shall be that USGS revision in effect at the time of the report and shall clearly note the facility location and property boundaries. When a portion of the USGS quadrangle is used, the scale (**including a bar scale**), north arrow, contour interval, longitude and latitude, along with the name and date of the USGS quadrangle shall be noted on the map;

iv. In addition, a wetlands map from the "National Wetlands Inventory" which provides a wetlands map superimposed on a USGS 7.5 minute topographic quadrangle shall be included;

v. Copies of boring logs from on-site construction; and

vi. Land use within a 1,000 foot radius of the site boundary including proximity of the site to environmentally sensitive areas and/or sensitive human receptors (for example, residences, schools, parks);

5. A description of each area of concern including dimensions, suspected contaminants, and suspected source of discharge;

6. An area of concern sampling summary table of proposed sampling and analysis shall be presented in the remedial investigation workplan text or on the

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sample location map specified in (b)7 below, according to the following headings (a suggested format is included in Table 4-1):

i. Location: Use the same alpha or numeric designation as shown on the scaled sampling location map;

ii. Matrix: Waste, soil, surface water, ground water, or sediment;

iii. Sample depth:

(1) Soil/sediment—depth of sample increment which will be analyzed;

(2) Ground water—indicate water bearing zone to be sampled (water table, confined, and semi-confined) and sample depth;

(3) Surface water—indicate depth of water sample.

iv. Analytical parameters for each sample (for example, priority pollutant metals, full priority pollutant scan); and

v. Sampling method;

7. Proposed sample locations shall be indicated on a sample location map, scaled as in (b)3i above. Sample locations may be superimposed on maps presented pursuant to (b)3i above;

8. Other sampling proposals including any proposals to conduct the following studies:

i. Treatability, bench scale, pilot studies pursuant to N.J.A.C. 7:26E-4.1(a)4i;

ii. Data necessary to develop discharge permit effluent limitations; and

iii. Ecological investigations for the purposes of characterizing natural resource injuries pursuant to N.J.A.C. 7:26E-4.7;

9. Quality assurance project plan including proposed sampling/ analytical methods pursuant to N.J.A.C. 7:26E-2.2; and

10. Health and safety plan pursuant to N.J.A.C. 7:26E-1.9.

TABLE 4-1  
Suggested Format Sampling Summary Table

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<u>Location</u>	<u>Medium</u>	<u>Sample Depth</u>	<u>Analytical Parameters</u>	<u>Sampling Method</u>
Area T:	Seepage Pit			
MWT-1	Ground Water	Water Table (20')	Priority Pollutants	Bailer
MWT-2	Ground Water	Water Table (20')	Priority Pollutants	Bailer
MWT-3	Ground Water	Water Table (20')	Priority Pollutants	Bailer
MWT-4	Ground Water	Confined (50')	Priority Pollutants	Bailer
Area S:	Drum Storage Pad			
S-1	Soil	0-6"	Priority Pollutant Metals and Cyanide	Trowel
S-2	Soil	0-6"	Priority Pollutant Metals and Cyanide	Trowel
		18-24"	Priority Pollutant Volatile Organics	Coring Device
S-3	Soil	0-6"	Priority Pollutant Metals and Cyanide	Trowel

**7:26E-4.3 Remedial investigation of soil**

(a) The remedial investigation shall include an investigation of all soil which may contain contaminants above the applicable soil remediation standards.

(b) The remedial investigation of the soil shall be conducted for the purposes of a remedial investigation pursuant to N.J.A.C. 7:26E-4.1 according to:

1. The quality assurance and quality control requirements pursuant to N.J.A.C. 7:26E-2; and
2. The technical requirements for soil investigation pursuant to N.J.A.C. 7:26E-3.6.

**7:26E-4.4 Remedial investigation of ground water**

(a) A remedial investigation of ground water for an area of concern shall be conducted if:

1. A ground water sample previously collected from that area of concern contains a contaminant above the applicable ground water remediation standard;
2. A soil sample collected from that area of concern within two feet of the saturated zone or bedrock contains a contaminant above the applicable soil remediation standard;
3. A soil sample collected in the area of concern anywhere in the soil column contains a contaminant above the applicable soil remediation standard and the contaminant is not going to be actively remediated or removed;
4. Any contaminant in an area of concern has a water solubility greater than 100 milligrams per liter at 20 degrees Celsius to 25 degrees Celsius as listed in a peer reviewed reference; and
  - i. All of the soil between the contaminant and the saturated zone is less than 15 percent silt and/or clay; or
  - ii. Any part of the area of concern at which the soil contamination was detected is located within 2,000 feet of a public supply well, as determined from a map of such wells which is available from the Department Bureau of Revenue—Maps and Publications (609-777-1038) or through the Department's Internet home page (<http://www.state.nj.us/dep/nigs>, then select "Geodata"). A ground water sample is not required if documentation acceptable to the Department is provided in the remedial investigation report (N.J.A.C. 7:26E-4.8) specifying why such sampling was not considered necessary.

(b) A ground water sample may not be necessary in a remedial investigation for a particular area of concern if the person responsible for conducting the remediation documents that ground water contamination from the discharge is unlikely based on the following criteria:

1. The date and duration of the discharge is known;
2. The identity and the volume of the contaminants are known;
3. The date the remediation in response to the single discharge was completed;
4. Post remediation soil sampling data establish that the remediation meets all applicable remediation standards at the time of the remedial action workplan approval or, in cases where the remedial action workplan did not require Department

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approval prior to initiation of the remedial action, in the approved remedial action report; and

5. Any other data or information that is relevant to the determination of the likelihood of ground water contamination.

(c) The remedial investigation of ground water shall be conducted for the purposes of a remedial investigation pursuant to N.J.A.C. 7:26E-4.1 according to:

1. The quality assurance and quality control requirements pursuant to N.J.A.C. 7:26E-2; and

2. The requirements in (d) through (i) below.

(d) Ground water samples shall be taken pursuant to acceptable professional methods, such as those described in the NJDEP Field Sampling Procedures Manual in effect as of the date the samples were taken. The person responsible for conducting the investigation may implement an alternate sampling method not described in the Manual, subject to the Department's review of documentation pursuant to N.J.A.C. 7:26E-1.6(c).

(e) All initial ground water sampling points shall be located in:

1. The excavation of each source of a contaminant, if possible, including without limitation, tanks and tank distribution systems, and Underground Injection Control (UIC) units such as seepage pits, septic systems, dry wells or other injection wells regulated under N.J.A.C. 7:14A-5; or

2. The expected downgradient flow direction of the area of concern and within 10 feet of the area of concern; ground water flow direction shall be predicted based on topographic relief, the location of surface water bodies, structural controls in the bedrock or soils, location of pumping wells and subsurface conduits at or below the water table.

(f) The minimum number of ground water samples collected shall be as follows:

1. At least one ground water sample for each area of concern which is classified as an Underground Injection Control (UIC) unit including, without limitation, seepage pits, septic systems, dry wells or other injection wells regulated under N.J.A.C. 7:14A-5;

2. At least one ground water sample for sites with leaking underground storage tanks and tank fields containing up to three tanks with a maximum capacity of 10,000 gallons per tank. If a leaking tank is excavated, the ground water sampling point shall be located within the excavation, if possible;



3. Pump islands and associated piping greater than 25 feet from the tank field shall be considered separate areas of concern and shall require a separate ground water sample location; and

4. At least one ground water sample for all other areas of concern unless the area of concern is within 10 feet hydraulically upgradient of a ground water sampling location.

(g) All ground water monitoring wells and piezometers shall:

1. Be constructed pursuant to N.J.A.C. 7:9D. Variations from the well construction procedures in N.J.A.C. 7:9D shall be proposed to the assigned case manager prior to requesting a variance under N.J.A.C. 7:9D. Failure to install a well or piezometer in accordance with current well construction specifications in N.J.A.C. 7:9D can result in rejection of results, and requirements to decommission the well or piezometer;

2. Be installed after the required well drilling permits are obtained pursuant to N.J.A.C. 7:9D;

3. Be installed by a licensed New Jersey well driller pursuant N.J.A.C. 7:9D;

4. Have split spoon samples collected during drilling through unconsolidated or overburden material using American Society of Testing Materials (ASTM) Method D1586-84, incorporated herein by reference, if appropriate. Split spoon samples shall be logged every five feet and at any change in soil lithology and at all zones that show obvious signs of contamination. At least one drilling location per area of concern shall include continuous split spoon samples to define the subsurface stratigraphy. Drilling logs shall include all data required pursuant to N.J.A.C. 7:26E-3.6 (Soil Investigations). Other methods may be used if documentation acceptable to the Department is provided indicating that the methods were appropriate;

5. Have a sufficient number of rock cores collected during the drilling of bedrock monitoring wells, piezometers and other borings, if appropriate, to obtain a general understanding of the fracture patterns beneath the site. The corings shall be conducted using the ASTM 2113 Diamond Drilling Method, as amended and supplemented, incorporated herein by reference. Other methods may be used if documentation acceptable to the Department is provided indicating that the methods were appropriate. The core logs shall include:

i. Lithology;

ii. Fracture frequency;

iii. Degree of weathering;

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- iv. Fracture spacing;
  - v. Orientation of fractures;
  - vi. Odors and discoloration in the rock core;
  - vii. Percent recovery; and
  - viii. Any other information appropriate for the investigation.
6. If appropriate, an evaluation of the bedrock structure at the site including strike and dip of the bedding planes, orientation of faults, joints and fractures; plunges and trends of folds, must be completed through a field evaluation. Published geologic literature may be used if appropriate.
7. Be surveyed by a New Jersey licensed surveyor as follows:
- i. The inner well casing must be surveyed to the nearest hundredth (0.01) foot in relation to the permanent, on-site datum and horizontally to an accuracy of one-tenth of a second latitude and longitude; and
  - ii. A permanent water level measurement mark shall be etched onto the top of the inner well casing to allow for accurate, consistent and comparable water level measurements over time.
8. Be developed to yield a non-turbid discharge, when possible;
9. Be **decommissioned** upon completion of the investigation in accordance with **N.J.A.C. 7:9D** unless otherwise approved by the Department;
10. Have the monitoring well permit number and site specific well identification number prominently displayed and permanently affixed to the monitoring well; and
11. Be constructed with a locking cap and generally protected from damage and vandalism. Any damage or vandalism to a monitoring well or piezometer shall be reported to the Department, and the damaged monitoring well or piezometer shall be properly repaired or decommissioned in accordance with **N.J.A.C. 7:9D**.
- (h) The results of initial ground water analyses shall be evaluated as follows:
- 1. If the contaminant concentrations found in all ground water samples are below the applicable remediation standards, no further remediation is necessary for ground water;

2. If the contaminant concentrations found in any ground water samples exceed the applicable remediation standard, the ground water may be resampled to confirm the presence of contamination. This confirmation sampling shall include at least two additional samples taken over a 30 day period, the results of which may be averaged with the original result to determine compliance with the applicable remediation standard; and

3. If ground water contamination above the applicable remediation standards has been confirmed, the person responsible for conducting the remediation shall perform the requirements in (h)3i through ix below. If the person responsible for conducting the remediation claims that groundwater contamination is from an offsite source, then a background ground water investigation shall be performed pursuant to N.J.A.C. 7:26E-3.7(f).

i. Delineate the vertical and horizontal extent of ground water contamination and the sources of ground water contamination, including, but not limited to, the extent of free and/or residual product as determined pursuant to N.J.A.C. 7:26E-2.1(a)11;

ii. Confirm the direction of groundwater flow in each affected aquifer or water bearing zone, using all monitoring wells located within each specific aquifer or water bearing zone pursuant to N.J.A.C. 7:26E-3.7(e)3iv; and

iii. Conduct aquifer tests, which may include pumping tests, packer tests, and slug tests or other appropriate analysis to adequately characterize the impacted aquifer at the site. At a minimum, this shall include the site water table gradient, hydraulic conductivity (K), and an estimate of the rate of ground water and contaminant flow in the aquifer. If pumping the aquifer is determined to be a feasible option for remediation, then additional aquifer characteristics such as transmissivity (T) and storativity (S) must be determined through the use of a pumping test;

iv. If a model to further define characteristics of the ground water flow system is used, documentation acceptable to the Department shall be provided in the remedial investigation report (N.J.A.C. 7:26E-4.8) indicating that the model was appropriate. Specific details on the type of model, input parameters used and referenced, boundaries and limitations of the model shall be submitted to the Department upon request along with a justification as to why the model was selected;

v. Perform an updated well search pursuant to N.J.A.C. 7:26E-3.7(e)3i, based on the results of:

(1) The delineation performed in (h)3i, above; and

(2) The confirmed groundwater flow direction determined in N.J.A.C. 7:26E-4.4(h)3ii, above;

vi. Sample any existing potable and supply wells identified pursuant to the well search which are suspected to be contaminated by the site in question;

vii. Evaluate any surface water body that may be impacted by the contaminated ground water pursuant to N.J.A.C. 7:26E-3.8 and 4.5 (Surface Water Investigations);

viii. Evaluate any subsurface utilities, basements or other structures to determine whether vapor hazards as a result of the ground water contamination may exist for receptors associated with the utility or structure. Measurement of oxygen levels, lower explosive limits (LEL) and the presence of organic vapors should be included in this evaluation; and

ix. Evaluate the current and potential ground water uses using a 25-year planning horizon utilizing municipal and water purveyor planning data.

(i) If geologic conditions are suitable, soil gas studies shall be conducted to locate sources of ground water contamination when ground water contamination by volatile organic compounds is identified but no apparent source is identified. If geologic conditions are not suitable for soil gas studies, other suitable field investigation techniques shall be used for source identification.

#### **7:26E-4.5 Remedial investigation of surface water, wetlands and sediment**

(a) The remedial investigation shall include an investigation of any surface water, wetlands and sediments which may have been impacted by contamination emanating from the site.

(b) The remedial investigation of surface water, wetlands and sediment shall be conducted for the purposes of a remedial investigation pursuant to the requirements for the appropriate media in N.J.A.C. 7:26E-3.4 and 4.1 according to the quality assurance and quality control requirements pursuant to N.J.A.C. 7:26E-2.

(c) The surface water investigation shall be conducted pursuant to (d) below to evaluate the relationship between contaminated ground water, sediments and surface waters, unless:

1. Documentation acceptable to the Department pursuant to N.J.A.C. 7:26E-1.6(c) is provided with the remedial investigation report (N.J.A.C. 7:26E-4.8) specifying why this migration pathway was not considered significant; or

2. The Department approves a less stringent water quality analysis:

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- i. Based on site-specific conditions; and
  - ii. Supported by appropriate supporting documentation.
- (d) The surface water investigation shall include:
1. Sampling designed to account for seasonal or short-term flow and water quality fluctuations (dry vs. wet weather), system hydraulics (obtaining flow proportioned samples) and potential contaminant characteristics (density, solubility).
  2. A receiving water body analysis on any surface water body to which contaminated ground water is discharging, including a water quality analysis program with sampling stations upstream and downstream of the contaminated site, any existing point source discharges at that site, and any proposed discharge locations as follows:
    - i. Procedures in accordance with the methods identified in (d)2ii below, including, without limitation:
      - (1) Water quality sampling for each constituent of concern potentially emanating from a site;
      - (2) At least two sample sets must be taken during critical, low flow conditions;
      - (3) At least one sediment sample shall be taken and analyzed for the appropriate parameters identified in (d)2i(1) above, during one of the sampling events;
      - (4) For non-tidal water bodies, samples shall be taken at the area of discharge, and at least one location downstream;
      - (5) For tidal water bodies, samples shall be taken at the area of discharge at high, low, and slack tides; and
      - (6) Depending upon site-specific conditions, additional samples may be necessary to define loads from other point sources, tributaries, and other non-point sources; and
    - ii. All methods shall be consistent with generally accepted professional methods, such as those described in the NJDEP "Field Procedures Manual For Water Data Acquisition," or the EPA handbook "Instream Sampling for Waste Load Allocation Applications;" any deviations from these two documents shall be documented pursuant to N.J.A.C. 7:26E-1.6.

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**7:26E-4.6 Remedial investigation of landfills and historic fill material**

(a) The remedial investigation shall include, unless the remedial investigation is being conducted pursuant to ISRA, an investigation of all landfills as follows:

1. The remedial investigation of landfills shall be conducted pursuant to N.J.A.C. 7:26E-4.1 according to the quality assurance and quality control requirements pursuant to N.J.A.C. 7:26E-2;

2. Landfill investigations shall characterize the contents of the landfill through a complete file review, which shall include a review of the Department's Geographic Information System. In addition, the horizontal and vertical extent of fill material and impact on the soil, ground water, air and surface waters shall be evaluated;

3. The boundaries of the landfill shall be identified through geophysical sensing techniques, or subsurface exploration techniques including test pits or borings, or an aerial photographic history, or local government records, or use of the Department's Geographic Information System. Other methods may be used if documentation acceptable to the Department pursuant to N.J.A.C. 7:26E-1.6(c) is provided in the remedial investigation report (N.J.A.C. 7:26E-4.8) specifying why the methods were considered appropriate; and

4. The person responsible for conducting the remediation shall review all records pertaining to the landfill to determine if any hazardous waste pursuant to N.J.A.C. 7:26 may have been disposed in the landfill.

(b) The remedial investigation of historic fill material shall identify the location of the fill and characterize the fill material, including a determination of the presence of any contaminated non-historic fill material and any free and/or residual product pursuant to N.J.A.C. 7:26E-2.1(a)11, as follows:

1. The remedial investigation of historic fill material shall be conducted to identify the location, vertical limits, and physical characteristics of the historic fill material using borings, test pits, or trenches. All contaminated fill material, including both historic and non-historic fill, shall be logged and mapped. The investigation shall include:

i. At least four borings or test pits per acre of historic fill material with a minimum of four borings or test pits per site. The location of the borings or test pits shall be representative of the areal extent of the fill and shall be advanced through the fill material to native soil, meadow mat, or bedrock so that the vertical limit of the fill material is established. If the contaminated fill material extends below the water table, borings or test pits shall extend below the water table as necessary to establish the vertical limit of the fill material;

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2. The remedial investigation of historic fill material shall identify the horizontal boundaries of the contaminated fill material area as follows:

i. A minimum of four borings or test pits shall be installed in non-fill areas spaced equidistantly around the perimeter of the contaminated fill material area;

ii. If fill material is known to be ubiquitous in the vicinity of the site, aerial photos or other applicable documentation, such as information obtained from the Department's Geographic Information System, may be submitted in lieu of perimeter borings or test pits to verify that historic fill is site-wide; and

iii. Delineation of historic fill material is not required beyond the property boundary;

3. The historic fill material may be characterized by using the optional historic fill database maximum and average contaminant levels for historic fill material as set forth in Table 4-2 below or by collecting and analyzing contaminant characterization samples from each type of historic fill present (for example, ash and demolition debris are considered to be different types of fill material) to determine the site specific contaminant levels, as follows:

i. At least four samples per acre, per fill type are required;

ii. The actual number and location of samples collected shall be based on the variability of fill types and contaminant ranges present in a historic fill area and selected in accordance with N.J.A.C. 7:26E-3.4(a);

iii. At least one sample for laboratory analysis shall be collected from each boring and analyzed as follows:

(1) Analysis of rubble, ash, cinders, and dredge spoils shall be conducted for total petroleum hydrocarbons and priority pollutant metals in all samples, polynuclear aromatic hydrocarbons (per EPA Priority Pollutant List) and PCB analysis required on 25 percent of the samples, biased to samples having the highest total petroleum hydrocarbon levels, and field screening for volatile organic compounds shall be conducted during the installation of all exploratory borings and test pits with volatile organic laboratory analysis performed on all samples with elevated field instrument measurements (greater than five times background);

(2) Any other fill material shall be analyzed for total petroleum hydrocarbon in all samples, and Priority Pollutant plus forty analysis or EPA Target Compound List/Target Analyte List analysis shall be conducted for 25 percent of all samples;

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(3) In addition to contaminant analysis required in (b)3iii(1) and (2) above, samples shall also be analyzed for any other suspected contaminants based on diligent inquiry of the origin of the fill material and site history; and

(4) If more than one type of historic fill material is encountered in any boring or test pit, one sample is required for each type of fill material encountered. For example, if ash and demolition debris are encountered in the same boring, one sample of each is required from that boring; and

4. Areas of concern located in historic fill material shall be investigated independently of the historic fill material. To differentiate between contaminants in fill and those from site discharges, an evaluation of the contaminant type and concentration gradient in each area of concern and the contaminant distribution in the fill shall be conducted. If this evaluation is not conclusive the Department may require additional data or information;

5. If at any time during the remedial investigation of fill material the person responsible for conducting the remediation encounters materials that do not meet the definition of historic fill material because it includes material which is substantially chromate chemical production waste or any other chemical production waste or waste from processing of metal or mineral ores, residues, slag or tailings, free and/or residual product, as determined pursuant to N.J.A.C. 7:26E-2.1(a)11, or containerized waste, the remediation of each such area shall be conducted as a separate area(s) of concern pursuant to N.J.A.C. 7:26E-4; and

6. An appropriate number of ground water samples (minimum of one sample) are required when a high degree of certainty is needed to document that ground water is not contaminated, including, without limitation, if the historic fill site is in an area where ground water is used for potable water. Any ground water sampling shall be conducted pursuant to N.J.A.C. 7:26E-3.7(c).

TABLE 4-2

Summary of Target Contaminant Concentrations in Typical Historic Fill Material (mg/kg)

<u>Contaminant (ppm)</u>	<u>Maximum</u>	<u>Average</u>
Benzo(a)anthracene	160	1.37
Benzo(a)pyrene	120	1.89
Benzo(b)fluoranthene	110	1.91
Benzo(k)fluoranthene	93	1.79
Indeno(1,2,3-cd)pyrene	67	1.41
Dibenz(a,h)anthracene	25	1.24
Arsenic	1098	13.15
Beryllium	80	1.23

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Cadmium	510	11.15
Lead	10700	574
Zinc	10900	575

**7:26E-4.7 Remedial investigation of ecological receptors**

(a) If further ecological investigation is required pursuant to N.J.A.C. 7:26E-3.11(a)4, additional investigation shall be conducted during the remedial investigation to characterize the extent of contamination along contaminant migration pathways and within an environmentally sensitive natural resources. Neither an ecological investigation nor an ecological risk assessment is required for contaminated ground water, but see N.J.A.C. 7:26E-4.8(c)12 for reporting requirements. Ecological investigations and risk assessments shall be conducted by a person experienced in the use of techniques and methodologies for conducting ecological risk assessments in accordance with EPA guidance. Ecological investigations and risk assessments shall be conducted in accordance with EPA and other Federal guidance, as applicable, including, without limitation, the following, incorporated herein by reference:

1. "Ecological Assessment of Hazardous Waste Sites: A Field and Laboratory Reference," EPA/600/13-89/013;
2. "Risk Assessment Guidance for Superfund, Volume II, Environmental Evaluation Manual," EPA/540/1-89/001, and the associated supplementary guidance Ecological Update Series—Volumes 2 and 4; and
3. "Framework for Ecological Risk Assessment," EPA/630/R-92/001;
4. Eisler, R., "Contaminant Hazard Reviews," Fish and Wildlife Service, U.S. Department of Interior, various dates;
5. EPA, "Wildlife Exposure Factors Handbook," Vol. I and II, EPA 600/R-93/187a, b;
6. EPA, "BTAG Forum," Intermittent Bulletin published by USEPA, Office of Emergency and Remedial Response;
7. EPA, "ECO Update," Intermittent Bulletin published by USEPA, Office of Emergency and Remedial Response;
8. Opresko, D.M., B.E. Sample and G.W. Suter, "Toxicological Benchmarks for Wildlife: 1994," Oak Ridge National Laboratory, Oak Ridge, TN; and
9. Will, M.E. and G.W. Suter II, "Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Terrestrial Plants: 1994 Revision," Oak Ridge National Laboratory, Oak Ridge, TN.

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(b) A site specific ecological risk assessment report, in accordance with (a) above, shall be completed during the remedial investigation and shall be submitted as part of the remedial investigation report. The ecological risk assessment report shall:

1. Describe actual impacts and potential risks to identified environmentally sensitive natural resources;
2. Present appropriate ecologically-based, site specific remediation standards for site contaminants of ecological concern, if applicable; and
3. Recommend measures for incorporation into the remedial action workplan, pursuant to N.J.A.C. 7:26E-6.2, to mitigate actual impact or ecological risks, if applicable.

#### **7:26E-4.8 Remedial investigation report**

(a) The remedial investigation report shall comply with all requirements in N.J.A.C. 7:26E-3.13 (site investigation report) and in addition shall present and discuss any additional information collected pursuant to N.J.A.C. 7:26E-4.1 through 4.7 and the approved remedial investigation workplan as outlined in N.J.A.C. 7:26E-4.2 if applicable. The remedial investigation report shall be presented in a format that corresponds to the outline of this section.

(b) The remedial investigation report shall include the following:

1. Historical information pursuant to N.J.A.C. 7:26E-4.2(b)3;
2. Physical setting pursuant to N.J.A.C. 7:26E-4.2(b)4, including but not limited to:
  - i. The results of the groundwater flow direction confirmation conducted pursuant to N.J.A.C. 7:26E-4.4(h)3ii; and
  - ii. The results of the updated well search conducted pursuant to N.J.A.C. 7:26E-4.4(h)3v, including a conclusion as to whether any wells may be impacted by the contaminant plume. The results of the well search shall be presented on the well search form at Appendix B.
3. Technical overview pursuant to N.J.A.C. 7:26E-3.13(b)3 and, in addition, the following items shall be discussed:
  - i. A summary of the results of any treatability, bench scale, or pilot studies conducted to support remedy selection;

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ii. A summary of the results of any data collected to develop permit limitations for any permits which may be required during potential remedial actions; and

iii. A summary of the results of any ecological assessments conducted; and

4. Findings/recommendations pursuant to N.J.A.C. 7:26E-3.13(b)4.

(c) The remedial investigation report shall include the following data and information:

1. Results of all analyses, copies of all laboratory data sheets and the required laboratory data deliverables pursuant to N.J.A.C. 7:26E-2.1 (Quality Assurance Requirements). Laboratory data deliverables may be submitted as a separate attachment;

2. A summary table of analytical methods and quality assurance indicators pursuant to N.J.A.C. 7:26E-2.2 (Quality Assurance Workplan);

3. Sampling Results Summary Table(s) of all analyses, including sample location, media, sample depth, and field and lab identification numbers pursuant to N.J.A.C. 7:26E-3.13(c)3 and, in addition:

i. All summary tables shall be organized by area of concern. For each area of concern, average concentrations for each contaminant shall be presented along with individual sample results if averaging will be used for compliance with applicable remediation standards.

(1) All contaminant concentrations exceeding the applicable remediation standard shall be identified; and

(2) Samples with MDLs (or PQLs if available) exceeding the applicable remediation standard shall be identified and an explanation provided in the table key; and

(3) If some contaminants are detected and quantified and some contaminants are "estimated" or non-detectable, for purposes of calculating the average, the person submitting the site investigation report shall substitute one half the reported method detection limit for all contaminants reported as non-detectable, and "estimated" values shall be included in the contaminant average "as is."

(4) "Non-detectable" values for contaminants in samples which have been diluted shall not be included in the area of concern average for those contaminants. "Detectable" values for contaminants in diluted samples shall be included in the area of concern average for those contaminants.

(5) The average shall be calculated for the contaminated area only, and shall not include clean zone data (data from outside the boundaries of the contaminated area as defined by samples contaminated greater than the applicable remediation standard). For example, if data points within a 50 foot "clean" buffer zone around an area of concern were identified during pre-remedial sampling, this clean zone shall not be included in the average. samples from different depth intervals shall not be averaged together to determine compliance with applicable remediation standards.

(6) Post excavation sample data shall not be averaged for compliance with applicable remediation standards.

ii. The data in the Sampling Results summary table shall be presented pursuant to N.J.A.C. 7:26E-3.13(c)3.

4. Stratigraphic logs, which include soil/rock physical descriptions and field instrument readings detected during drilling for each soil boring, test pit and monitoring well, if applicable:

i. For fill material and historic fill material the logs shall include a description of fill type, any layering of the fill material, texture and size of materials, an assessment of fill homogeneity, field indicators of contamination including, without limitation, odors, staining or other discoloration, and field measurements of organic vapors using a calibrated PID/FID or other suitable instrument. The presence of any process waste including metal processing waste such as slag, tailings or free and/or residual product determined pursuant to N.J.A.C. 7:26E-2.1(a)11 shall be noted;

5. Stratigraphic cross sections of the site using information from monitoring wells, test pits and borings;

6. All soil boring, piezometer, and monitoring well records, including the State permit numbers and as-built specifications, if applicable;

7. For each monitoring well sampled, the information required pursuant to N.J.A.C. 7:26E-3.13(c)7 shall be reported for each ground water sampling event.

8. If applicable, ground water elevation, for each monitoring well, to the nearest hundredth (0.01) foot relative to a permanent, on-site datum taken prior to evacuation, from the top of well casing with locking cap removed;

9. A summary of the review of inventory control records to identify product loss and any actions taken to investigate potential discharge areas;

10. Results of any treatability, bench scale, or pilot studies or other data collected to support remedy selection;

11. Any data collected to develop permit limitations;

12. The results of any ecological assessments and evaluations conducted, including, without limitation, characterization of natural resource injuries, in accordance with N.J.A.C. 7:26E-4.7(b). This information shall be submitted in a format compatible with the Department's Geographic Information System (see N.J.A.C. 7:1D Appendix A. For additional guidance, see the version of the Department's "Guidance for the Submission and Use of Data in GIS Compatible Formats" most recent to the time of submission. This guidance document may be found at <http://www.state.nj.us/dep/srp/regs/techgis/techgis05.htm>). In lieu of an ecological investigation or an ecological risk assessment for ground water, the person responsible for conducting the remediation shall include the following information in the remedial investigation report:

- i. The area of contaminated ground water plume;
- ii. The degradability of the individual ground water contaminants; and
- iii. The period during which the ground water is estimated to exceed the applicable ground water quality standards;

13. For landfills, a summary of any records pertaining to the nature of waste disposed at the landfill. Copies of the records shall be submitted as a separate attachment to the report;

14. For historic fill material, the following documentation shall be submitted:

- i. A statement that, based on diligent inquiry of the history of the parcel of land, including use of the Department's Geographic Information System, the fill material is non-indigenous material, was used to replace soil in an area or raise the topographic elevation of the site, was contaminated prior to emplacement, and was in no way connected with the operations at the location of emplacement; and
- ii. A statement that, based on the results of the remedial investigation, the historic fill material does not include any material which is substantially chromate chemical production waste or any other chemical production waste or waste from processing of metal or mineral ores, residues, slag or tailings; and

15. Any other data and information obtained pursuant to N.J.A.C. 7:26E-4.1 through 4.7.

(d) The remedial investigation report shall include the following legible maps and diagrams:

1. Site and area of concern base maps pursuant to N.J.A.C. 7:26E-4.2(b)3i. If more than one map is submitted pursuant to (d)2 below, maps shall be presented as overlays, keyed to the base map or each map shall include all the information shown on the base map. Sample locations may be superimposed on the base maps.

2. Sample location map(s), including:

i. All ground water, soil, sediments and other sample locations; sample depth and contaminant concentration shall also be plotted on the map;

ii. Map scale (including bar scale) and orientation (including north arrow);

iii. Field identification numbers for all samples;

iv. A groundwater elevation contour map and a completed Contour Map reporting Form (see Appendix G) for each set of static water level measurements for each aquifer for which groundwater flow was determined, indicating the direction of groundwater flow and site features, and including a north arrow and appropriate bar scale;

v. Top of bedrock contour map if bedrock was encountered in a sufficient number of borings to prepare a map;

vi. Isopleth maps for ground water contaminant concentrations for each round of sampling; isopleth maps for soil sample results may also be provided;

vii. Maps depicting the horizontal and vertical extent of any free and/or residual product zones in ground water or soil, as determined pursuant to N.J.A.C. 7:26E-2.1(a)11, for each round of sampling;

viii. If data for more than 25 samples are presented for an area of concern, soil, ground water and sediment contaminant isopleth maps and cross section diagram(s) showing concentrations of potential contaminants shall be submitted, including:

(1) Horizontal and vertical distribution of contaminants in the soil and sediment, with sample point location numbers and contaminant concentrations; and

(2) Horizontal and vertical distribution of contaminants in the ground water, with sample point location numbers and contaminant concentrations; and



- ix. All monitoring well, piezometer, or other ground water sampling point locations including depth of the open borehole interval and/or screened interval;
- 3. If applicable, map of the distribution of surface water, structure and airborne contaminants, including sample location numbers and contaminant concentrations;
- 4. The same alpha or numeric labels, if assigned in the remedial investigation workplan, shall be used in the remedial investigation report; and
- 5. Photos may be submitted to document the location of all soil and sediment sample locations.